STORMFLOW AND BASEFLOW CONCENTRATIONS AND YIELDS OF TOTAL NITROGEN FOR WATERSHEDS IN GWINNETT COUNTY, GEORGIA

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Abstract. One challenge accompanying rapid development in the Metropolitan Atlanta area is to protect stream resources for drinking water supplies, recreational opportunities, and ecosystems. Monitoring of streams is critical to informed watershed management that will protect stream resources. Long-term monitoring using consistent methods is essential to measure stream-quality status and trends and to evaluate development impacts and watershed management effectiveness. Results from an ongoing monitoring program in six watersheds of Gwinnett County, Georgia, have been used to compute and to delineate the baseflow and stormflow components of watershed load and yield for selected constituents.

Gwinnett County lies in northeastern Metropolitan Atlanta, Georgia, and is one of the most rapidly developing counties in the United States. The watershed-monitoring network for Gwinnett County was designed in 1996. The six monitoring watersheds shown in Figure 1 were selected based on size, land use, parent basin, and suitability for instrumentation and measurement. Stream gages were constructed to continuously monitor stage, streamflow, and precipitation; to collect periodic water-quality samples; and to transmit data via satellite. At each site, three storm composite samples and three dry weather samples are collected every 6 months. Discharge measurements also are routinely made to define a stage-discharge relation at each site. This report includes data collected through September 2001.

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Streamflow discharge and constituent concentration are basic measurement data for assessing stream health. The quality of a stream is often stated in terms of its water chemistry and the concentration of selected constituents relative to established water-quality standards. Total phosphorus concentrations during stormflow and during baseflow are shown for six watersheds in Figure 2. Phosphorus concentrations are much higher during stormflow than during baseflow. At baseflow, the concentrations are often less than laboratory detection limits. The concentrations of total phosphorus, and many other sediment-associated, nonpoint-source constituents, have separate populations during baseflow and stormflow. This has implications for how these constituents affect the aquatic ecosystem, and on how they may be managed and controlled.

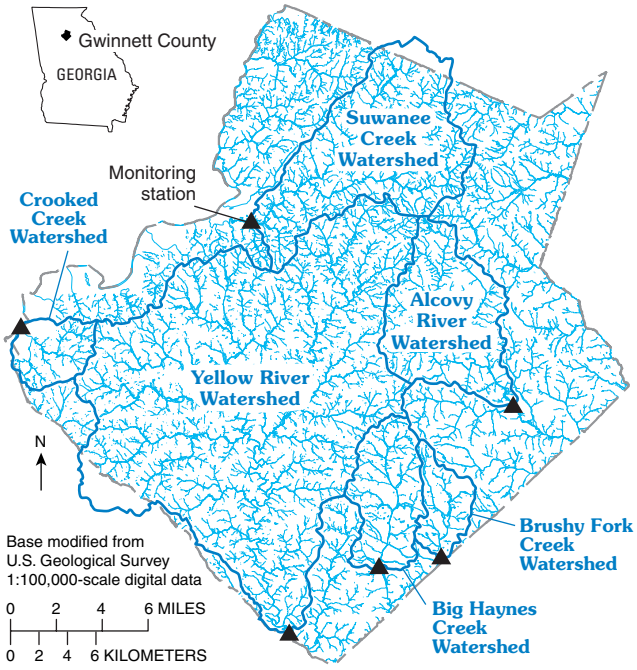

Figure 1. Gwinnett County watershed water-quality monitoring network.

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While concentration indicates stream water quality at the instant of measurement, the load and yield of a constituent characterize cumulative watershed processes over time, relative to that constituent. In simple

terms, constituent load is the product of concentration and discharge. Loads are computed using a relatively direct load model (Crawford, 1996) that is calibrated using sample data. The model is calibrated and run separately for stormflow and baseflow conditions. The results are illustrated below for total nitrogen, averaged for the six Gwinnett County watersheds in this study. Yield is expressed as the total nitrogen load per unit area of the watershed for a specified period of time.

The seasonal and annual variations of total nitrogen yield with stream discharge are shown in Figure 3. The total nitrogen yield in 1998 was about twice that of any of the next 3 years, characterized by drought conditions. The relative contribution of stormflow and baseflow to total yield depends on the affinity of a constituent for the solid or dissolved phase, and on the constituent sources in the watershed. Baseflow accounts for 35 percent of the total nitrogen, on average for these six streams (Fig. 2). Baseflow nitrogen comes primarily from treated wastewater point sources in three of the watersheds. For some parameters, nearly all of the yield may be associated with stormflow. For example, in these six watersheds only 1 percent of the average annual yield of total suspended solids is carried during baseflow. The remainder is carried during stormflow, indicating that sediment is almost entirely a nonpoint-source issue. These findings are relevant to analyses of total maximum daily load, to watershed assessments, and to watershed management strategies.

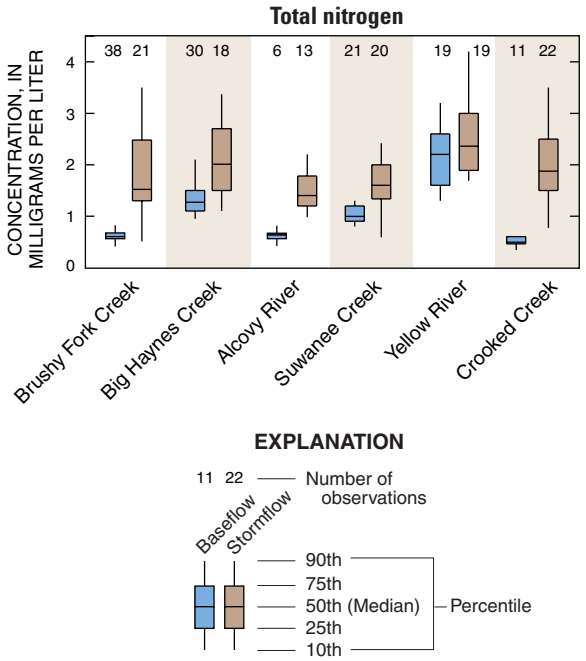

Figure 2. Total phosphorus concentrations for baseflow and stormflow conditions for six watersheds in Gwinnett County, Georgia.

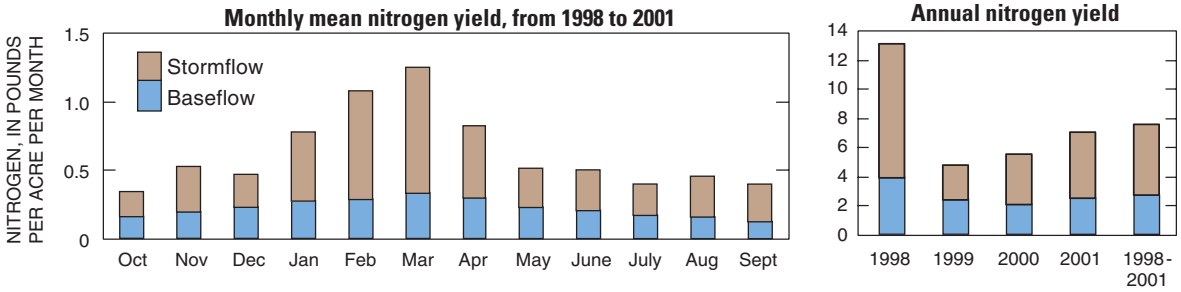

Figure 3. Average nitrogen yield for six watersheds in Gwinnett County, Georgia.

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